

CLAIMS

1. A non-aqueous electrolyte primary battery characterized by dispersing at least one alkaline earth metal oxide selected from the group consisting of magnesium oxide, calcium oxide and barium oxide between particles of manganese dioxide.

2. A non-aqueous electrolyte primary battery according to claim 1, wherein the alkaline earth metal oxide is calcium oxide.

3. A non-aqueous electrolyte primary battery according to claim 1 or 2, wherein a mass of the alkaline earth metal oxide is 0.5-4% based on a mass of manganese dioxide.

4. A non-aqueous electrolyte primary battery according to any one of claims 1 to 3, wherein the alkaline earth metal oxide has a particle size of 10-80 nm.

5. A method of producing a positive electrode for a non-aqueous electrolyte primary battery, which comprises the steps of:

(I) a step of adding an aqueous solution of at least one alkaline earth metal hydroxide selected from the group consisting of an aqueous solution of magnesium hydroxide, an aqueous solution of calcium hydroxide and an aqueous solution of barium hydroxide to manganese dioxide while cooling below 15°C and then mixing them with stirring to prepare a mixed solution;

(II) a step of raising a temperature of the mixed solution to 45-55°C at a rate of 1-10°C/min to reduce a water content of the mixed solution and further to 65-85°C at a rate of 10-15°C/min to remove the water content of the mixed solution to thereby form a mixture of manganese dioxide and alkaline earth metal hydroxide;

(III) a step of raising a temperature of the mixture to 290-310°C and holding at this temperature for a given time to convert the alkaline earth metal hydroxide into an alkaline earth metal oxide to thereby prepare powder for a positive electrode dispersing the alkaline earth metal oxide between particles of manganese dioxide; and

(IV) a step of shaping the powder for a positive electrode to produce a positive electrode.

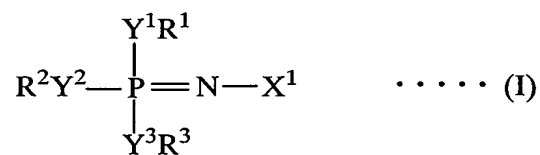
6. A method of producing a positive electrode for a non-aqueous

electrolyte primary battery according to claim 5, wherein the aqueous solution of the alkaline earth metal hydroxide is an aqueous solution of calcium hydroxide.

7. A non-aqueous electrolyte primary battery comprising a positive electrode as claimed in any one of claims 1 to 4, a negative electrode, and an electrolyte comprising an aprotic organic solvent and a support salt.

8. A non-aqueous electrolyte primary battery according to claim 7, wherein the aprotic organic solvent is added with a phosphazene derivative and/or an isomer of a phosphazene derivative.

9. A non-aqueous electrolyte primary battery according to claim 8, wherein the phosphazene derivative has a viscosity at 25°C of not more than 300 mPa·s (300 cP) and is represented by the following formula (I) or (II):



(wherein R^1 , R^2 and R^3 are independently a monovalent substituent or a halogen element, X^1 is a substituent containing at least one element selected from the group consisting of carbon, silicon, germanium, tin, nitrogen, phosphorus, arsenic, antimony, bismuth, oxygen, sulfur, selenium, tellurium and polonium, and Y^1 , Y^2 and Y^3 are independently a bivalent connecting group, a bivalent element or a single bond), or



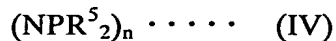
(wherein R^4 is a monovalent substituent or a halogen element, and n is 3-15).

10. A non-aqueous electrolyte primary battery according to claim 9, wherein the phosphazene derivative of the formula (II) is represented by the following formula (III):



(wherein n is 3-13).

11. A non-aqueous electrolyte primary battery according to claim 9, wherein the phosphazene derivative of the formula (II) is represented by the following formula (IV):



(wherein R^5 is a monovalent substituent or a halogen element, and at least one of

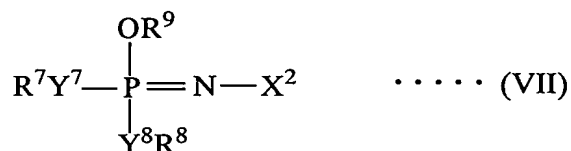
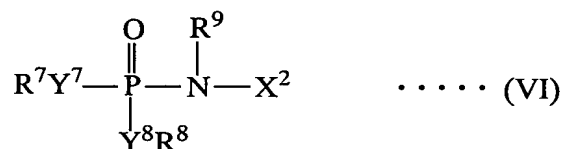
all R⁵s is a fluorine-containing monovalent substituent or fluorine, provided that all R⁵s are not fluorine, and n is 3-8).

12. A non-aqueous electrolyte primary battery according to claim 8, wherein the phosphazene derivative is a solid at 25°C and is represented by the following formula (V):



(wherein R⁶ is a monovalent substituent or a halogen element, and n is 3-6).

13. A non-aqueous electrolyte primary battery according to claim 8, wherein the isomer of the phosphazene derivative is represented by the following formula (VI) and is an isomer of a phosphazene derivative represented by the following formula (VII):



(in the formulae (VI) and (VII), R⁷, R⁸ and R⁹ are independently a monovalent substituent or a halogen element, X² is a substituent containing at least one element selected from the group consisting of carbon, silicon, germanium, tin, nitrogen, phosphorus, arsenic, antimony, bismuth, oxygen, sulfur, selenium, tellurium and polonium, and Y⁷ and Y⁸ are independently a bivalent connecting group, a bivalent element or a single bond).

14. A non-aqueous electrolyte secondary battery characterized by dispersing at least one alkaline earth metal oxide selected from the group consisting of magnesium oxide, calcium oxide and barium oxide between particles of at least one lithium-containing composite oxide selected from the group consisting of LiCoO₂, LiNiO₂ and LiMn₂O₄.

15. A non-aqueous electrolyte secondary battery according to claim 14, wherein the alkaline earth metal oxide is calcium oxide.

16. A non-aqueous electrolyte secondary battery according to claim 14 or 15, wherein a mass of the alkaline earth metal oxide is 0.5-4% based on a mass of

the lithium-containing composite oxide.

17. A non-aqueous electrolyte secondary battery according to any one of claims 14 to 16, wherein the alkaline earth metal oxide has a particle size of 10-80 nm.

18. A method of producing a positive electrode for a non-aqueous electrolyte secondary battery, which comprises the steps of:

(I) a step of adding an aqueous solution of at least one alkaline earth metal hydroxide selected from the group consisting of an aqueous solution of magnesium hydroxide, an aqueous solution of calcium hydroxide and an aqueous solution of barium hydroxide to at least one lithium-containing composite oxide selected from the group consisting of LiCoO_2 , LiNiO_2 and LiMn_2O_4 while cooling below 15°C and then mixing them with stirring to prepare a mixed solution;

(II) a step of raising a temperature of the mixed solution to $45\text{-}55^\circ\text{C}$ at a rate of $1\text{-}10^\circ\text{C}/\text{min}$ to reduce a water content of the mixed solution and further to $65\text{-}85^\circ\text{C}$ at a rate of $10\text{-}15^\circ\text{C}/\text{min}$ to remove the water content of the mixed solution to thereby form a mixture of lithium-containing composite oxide and alkaline earth metal hydroxide;

(III) a step of raising a temperature of the mixture to $290\text{-}310^\circ\text{C}$ and holding at this temperature for a given time to convert the alkaline earth metal hydroxide into an alkaline earth metal oxide to thereby prepare powder for a positive electrode dispersing the alkaline earth metal oxide between particles of the lithium-containing composite oxide; and

(IV) a step of shaping the powder for a positive electrode to produce a positive electrode.

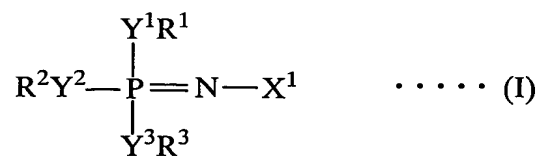
19. A method of producing a positive electrode for a non-aqueous electrolyte secondary battery according to claim 18, wherein the aqueous solution of the alkaline earth metal hydroxide is an aqueous solution of calcium hydroxide.

20. A non-aqueous electrolyte secondary battery comprising a positive electrode as claimed in any one of claims 14 to 17, a negative electrode, and an electrolyte comprising an aprotic organic solvent and a support salt.

21. A non-aqueous electrolyte secondary battery according to claim 20, wherein the aprotic organic solvent is added with a phosphazene derivative

and/or an isomer of a phosphazene derivative.

22. A non-aqueous electrolyte secondary battery according to claim 21, wherein the phosphazene derivative has a viscosity at 25°C of not more than 300 mPa·s (300 cP) and is represented by the following formula (I) or (II):



(wherein R^1 , R^2 and R^3 are independently a monovalent substituent or a halogen element, X^1 is a substituent containing at least one element selected from the group consisting of carbon, silicon, germanium, tin, nitrogen, phosphorus, arsenic, antimony, bismuth, oxygen, sulfur, selenium, tellurium and polonium, and Y^1 , Y^2 and Y^3 are independently a bivalent connecting group, a bivalent element or a single bond), or



(wherein R^4 is a monovalent substituent or a halogen element, and n is 3-15).

23. A non-aqueous electrolyte secondary battery according to claim 22, wherein the phosphazene derivative of the formula (II) is represented by the following formula (III):



(wherein n is 3-13).

24. A non-aqueous electrolyte secondary battery according to claim 22, wherein the phosphazene derivative of the formula (II) is represented by the following formula (IV):



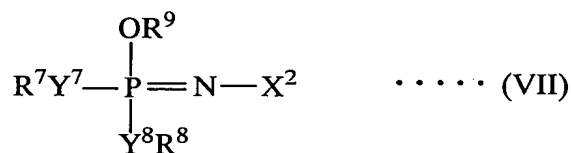
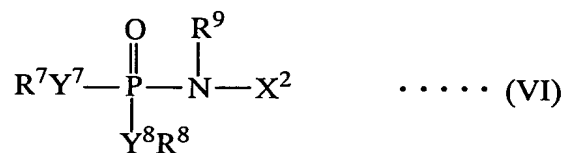
(wherein R^5 is a monovalent substituent or a halogen element, and at least one of all R^5 s is a fluorine-containing monovalent substituent or fluorine, provided that all R^5 s are not fluorine, and n is 3-8).

25. A non-aqueous electrolyte secondary battery according to claim 21, wherein the phosphazene derivative is a solid at 25°C and is represented by the following formula (V):



(wherein R^6 is a monovalent substituent or a halogen element, and n is 3-6).

26. A non-aqueous electrolyte secondary battery according to claim 21, wherein the isomer of the phosphazene derivative is represented by the following formula (VI) and is an isomer of a phosphazene derivative represented by the following formula (VII):



(in the formulae (VI) and (VII), R^7 , R^8 and R^9 are independently a monovalent substituent or a halogen element, X^2 is a substituent containing at least one element selected from the group consisting of carbon, silicon, germanium, tin, nitrogen, phosphorus, arsenic, antimony, bismuth, oxygen, sulfur, selenium, tellurium and polonium, and Y^7 and Y^8 are independently a bivalent connecting group, a bivalent element or a single bond).